(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 193 958 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.01.2004 Bulletin 2004/02

(51) Int Cl.[7]: **H04M 3/30**

(21) Application number: **01303329.5**

(22) Date of filing: **09.04.2001**

(54) **Metallic testing of a subscriber loop that provides both voice and digital subscriber line services**

Metallische Prüfung einer Teilnehmerschleife mit Sprach- und digitalen Teilnehmerleitungdiensten

Test métallique d'une boucle d'abonné fournissant des services vocaux et des services de ligne d'abonné numérique

(84) Designated Contracting States:
DE FR GB IT NL SE

(30) Priority: **29.09.2000 US 675884**

(43) Date of publication of application:
03.04.2002 Bulletin 2002/14

(73) Proprietor: **LUCENT TECHNOLOGIES INC.**
Murray Hill, New Jersey 07974-0636 (US)

(72) Inventor: **Posthuma, Carl Robert**
Wheaton, Illinois 60187 (US)

(74) Representative:
Buckley, Christopher Simon Thirsk et al
Lucent Technologies Inc.,
5 Mornington Road
Woodford Green, Essex IG8 0TU (GB)

(56) References cited:
EP-A- 1 005 209 **US-A- 4 791 659**

- **"ADSL TESTING MOVES OUT OF THE LAB" TEST AND MEASUREMENT WORLD. (INC. ELECTRONICS TEST), CAHNERS PUBLISHING, DENVER, US, vol. 19, no. 5, April 1999 (1999-04), pages 46-48,50,52,54, XP000822854 ISSN: 0744-1657**

EP 1 193 958 B1

Description

[0001] A relatively new technology uses the embedded voice telephone infrastructure to provide high speed data service. This service, generally referred to as "Digital Subscriber Line" (DSL) service, is available in many markets. DSL is implemented in several different ways, such as asymmetrical DSL (ADSL where upstream and downstream have different bandwidths), symmetrical DSL (SDSL where upstream and downstream have the same bandwidth) and other varieties of services (herein "XDSL" or "DSL"). Many XDSL technologies provide high speed data service over the current tip-ring pairs by encoding high speed data signals into frequency ranges well above the frequency range that carries both plain old telephone service ("POTS") or integrated services digital network (ISDN) service. Thus, one subscriber loop comprising a tip-ring pair can provide both voice service and high speed data service.

[0002] One problem facing service providers in this fast growing market is loop maintenance. Specifically, most regulatory bodies require that each subscriber loop is tested for power cross, over-voltage, etc. as is known in the art. However, because incumbent voice service providers may be a different entity from the DSL service provider, testing the loop over the entire frequency spectrum (known in the art as "D.C. to light") requires new and relatively sophisticated and expensive equipment.

[0003] Turning now to FIG. 1, a current metallic test system is illustrated in the context of metallic testing of a subscriber loop 5. Subscriber loop 5 subscribes to both voice and DSL services. In a switching office 10, there is a voice switch 12 and a digital subscriber line access multiplexer (DSLAM) 14, which provide voice and data service for subscriber loop 5, respectively. Voice switch 12 is connected to subscriber loop 5 by line card 16 as is known in the art. Line card 16 includes processing unit 18 which sends and receives analog signals over subscriber loop 5 and processes the signals to/from pulse code modulated (PCM) data, as used in the switching network as is known in the art. DSLAM 14 includes a line card 20 which sends and receives data from loop 5 to and from the data network via transceiver 22.

[0004] Voice switch 12 and, more specifically, processing unit 18 supports analog signals in the 0 - 4 kHz band over subscriber loop 5. Generally, DSLAM 14, and more specifically transceiver 22 on line card 20, supports signals in the 32 - 1,100 kHz range over subscriber loop 5.

[0005] DSL introduces frequency and, more importantly, power characteristics that are incompatible with most current art voice service line cards. Conversely, voice service uses DC power with characteristics that interfere with DSL data. Therefore, a splitter 24 is provided in order to filter unwanted characteristics from the subscriber loop 5 for processing at processor 18 on voice line card 16 and DSL line card 20. To enhance the voice signal, splitter 24 includes low-pass filter 26, which attenuates the high voltage of DSL and generally filters out the high frequency DSL signal. To enhance the DSL signal, the DC component of signals on subscriber loop 5 are filtered by a capacitor 28 on line card 20 and a further capacitor 30 in splitter 24.

[0006] It is known in the art that voice switches include a voice switch metallic test unit 32 that tests loop 5 for various faults. Metallic test unit 32 is connected to line card 16 via metallic test bus 34. Metallic test bus 34 is connected through a set of relays 36 comprising a normally closed relay 38 and a normally open relay 40. This set of relays 30 is reversed when voice switch metallic test unit 32 tests loop 5 to protect the circuitry of processing unit 18 on line card 16. Likewise, DSLAM 14 includes DSLAM metallic test unit 42 which is connected to line card 20 via metallic test bus 44 to relays 46 including normally closed relay 48 and normally opened relay 50.

[0007] In order to effect a usable path through splitter 24 for either metallic test unit 32 or 42, several additional components must be included in splitter 24. For example, in order to test loop 5 from voice switch metallic unit 32, a signature 52 must be present in order to alert voice switch metallic unit 32 of the voltage loss that will occur because of the presence of splitter 24. If signature 52 were not present, then any estimates of broken cable etc. would be incorrect.

[0008] Further, a detector 54 needs to be added to splitter 24 in order to detect whether the voice path is currently in use. An additional detector 56 is needed to detect signals from DSLAM metallic test unit 42 which will inform processor 58 that metallic test unit 42 is going to test loop 5. When this occurs, processor 58 closes normally open relay 60 and opens normally closed relay 62 in order to permit testing from DSLAM metallic test unit 42 without interfering with line card 16 on voice switch 12. All of these additional units not only are costly but also require a power supply 64 in order to operate. All of these units also then need to be diagnosed, fused, maintained, alarmed, etc. as is known in the art.

[0009] EP-A-1005209 shows a remote network interface unit (NIU) which performs a two phase test. In phase one, the remote NIU sends a signal back to the voice and DSL switches to test the tip and ring lines. In phase two, the remote DSL filter and the remote DSL modem are disconnected and a connection to the remote customer premises equipment (CPE) is effected so the voice switch can test the remote CPE. The testing is initiated by a battery reversal across the tip and ring lines and a timer sequences phase one and phase two testing thereafter.

[0010] US-A-4,791,659 shows an improved remote test system for remotely testing a telephone line with any conventional telephone test set without introducing errors or "hits" to the line. This remote test access system uses a fixed reference delay which is always in the signal path and a variable delay which is in the rest of the

test path and is varied so that the sum of the variable delay and the test set delay equals the fixed reference delay. Some of the delay is part of a special line card used during testing. The delay allows a standard test set to be switched in and run some tests without synchronization errors.

[0011] *ADSL Testing Moves Out Of The Lab*, from Test & Measurement World April 1999 edition discusses how telephone service companies are providing plain old telephone services (POTS) and also digital subscriber line (DSL) service. This article shows how a line is set up and how in various ways it can be tested. It shows a system with a splitter at the central office and filters on each branch of the line inside the subscriber's home. A variation of DSL called ADSL-lite is also discussed along with the fact that ADSL lite is splitterless at the central office end, but does not explain much more about it. It shows a splitter at the central office end and filters at the remote end it has the expense of the splitter and the filters for each line. These components make testing of the sending and receiving equipment more difficult.

[0012] According to one aspect of this invention there is provided a system as claimed in claim 1.

[0013] According to another aspect of this invention there is provided a method as claimed in claim 11.

[0014] According to a further aspect of this invention there is provided a method as claimed in claim 16.

[0015] A technical advance is achieved in the art by a system and method for metallic testing of a subscriber loop that provides voice and DSL services. Voice services are provided by a voice switch and DSL services are provided by a digital subscriber line access multiplexer (DSLAM); each of which includes a metallic test unit. A voice line card in the voice switch has a connection to a first metallic test bus connected to the voice switch metallic test unit via a first set of relays configured to connect the metallic test bus to the subscriber loop and to disconnect the subscriber loop from voice on the line card when testing is performed. A DSL line in the DSLAM card has a connection to a second metallic test bus, which is connected between the DSLAM metallic test unit and the subscriber loop. A second set of relays control the connection of the metallic test bus to the subscriber loop.

[0016] In this environment, the voice switch metallic test system is configured to send signals to control the second set of relays to disconnect the DSL line card and to provide metallic tests over the entire wireline spectrum (DC to light). The DSL metallic test unit connected to the second metallic test bus is configured to send signals to control the first set of relays to disconnect the DSL line card and to provide metallic tests from DC to light. Advantageously, a determination is made whether there is traffic on either the voice line or the DSL line prior to metallic testing. The metallic test may then be run and then, for example, a timer may cause the relays to reset to their original state. Further, a detector on each of the line cards may receive out-of-band signaling from the metallic test units and cause the relays to operate.

Brief Description of the Drawings

[0017] A more complete understanding of the invention may be obtained from a consideration of the following description, taken in conjunction with the drawings, in which:

FIG. 1 is a block diagram of a prior art central office wherein XDSL is provided;
FIG. 2 is a block diagram of a system for metallic testing of a subscriber loop from both the voice switch and the DSL switch, according to an exemplary embodiment of this invention;
FIG. 3 is a flowchart of operation in the voice metallic test system in the context of FIG. 2; and
FIG. 4 is a flowchart of operations in an XDSL metallic test system in the context of FIG. 2.

Detailed Description

[0018] FIG. 2 is a block diagram of a system that effects metallic testing of a subscriber loop from both a voice switch 200 and a digital subscriber line access multiplexer (DSLAM) also called a DSL switch 202. A DSL-ready POTS line card 204 is connected to the switching core of voice switch 200 through a pulse code modulated (PCM) connection 206. DSL-ready POTS line card 204 is also connected to the voice switch 200 metallic test unit 208 via metallic test bus 210. For purposes of this description, plain old telephone service (POTS) also includes integrated services digital network (ISDN) service. Both POTS and ISDN use the same low frequency band and perform metallic testing in a similar, and in some cases, identical manner. A DSL-ready line card as described herein is more fully described in U.S. Patent Application No. 09/650,050.

[0019] The embodiment of the line card described herein is exemplary; it is within the ability of one skilled in the art to modify this embodiment to meet the needs of different line card configurations without departing from the scope of the claims.

[0020] DSL-ready line card 204 comprises four main components. According to this exemplary embodiment, DSL-ready line card 204 comprises a compensating digital signal processor 212, a CODEC or digital/analog, analog/digital converter 214 and a battery feed 216. In addition, a second-order, low-pass filter is included 218. For a more complete description of the functionality of POTS line card 204, see, U.S. Patent Application 09/650,050 .

[0021] Additionally, there are two relay pairs 220 and 222 which connect and disconnect metallic test bus to tip-ring pair 223.Each pair 220 and 222 comprises a normally closed relay 224 that normally connects tip-ring pair 223 to low-pass filter 218, and a normally open relay

226. These relays are controlled by a processor 228. When a metallic test is performed, processor 228 causes relays 224 to open and relays 226 to close, thus connecting voice switch metallic test unit 208 to tip-ring pair 223via metallic test bus 210 (and removing the components 212, 214, 216 and 218 from the metallic test bus and loop where voltages and signals are present that could damage sensitive circuits).

[0022] XDSL line card 240 likewise sends and receives signals on tip-ring pair 223. XDSL line card 240 includes a DC blocking and low frequency filter shown as capacitors 242. Transceiver 244 sends and receives data over tip-ring pair 223 and sends and receives data from the data network over line 246 to the data network.

[0023] XDSL line card 240 also includes two pair of relays 250 and 252 comprising normally closed relays 254 and normally open relays 256. As above, when a metallic test is to be run from DSLAM by metallic test unit 258 on tip-ring pair 223, processor 256 causes relays 250 and 252 to open relays 254 and close relays 256 thus connecting DSLAM metallic test unit 258 to tip-ring pair 223via metallic test bus 260. Optionally, detectors 262 and 264 (shown in phantom) detect when either of the metallic units 208, 258 is testing as will be described further below in connection with FIGs. 3 and 4.

[0024] Turning now to FIG. 3, a flowchart is shown for control of DSLAM metallic unit 258 testing tip-ring pair 223 .Processing starts in oval 300 and proceeds to action box 305 wherein processor 256 causes relay pairs 250 and 252 to open normally closed relay 254 and close normally opened relay 256, thus disconnecting transceiver 244 from tip-ring pair 223. This action also connects DSLAM metallic test unit 258 to tip-ring pair 223via metallic test bus 260. Processing then moves to decision diamond 310 where a determination is made whether there is activity in the voice frequency. This step may be accomplished by sending a signal from DSLAM metallic test unit 258 over metallic test bus 260 across tip-ring pair 223 to either a detector 262 or to CODEC 214 via low-pass filter 218 and feed 216. The signal is, in this exemplary embodiment, a 10 - 16 kHz AC signal (between the voice and the XDSL band). Other frequency AC or DC signals may also be used. The AC signal is received and processor 228 notified that the DSLAM metallic test unit 258 wants to test loop 223. This signal is detected either by detector 262, CODEC 214 or feed 216. Processor 228 then queries CODEC 214 to determine if speech is currently being processed. Alternatively, detector 262 or even DSLAM metallic test unit 258 may determine whether there is energy on tip-ring pair 223 in the voice frequency range that is above a predetermined threshold. A response is sent back to DSLAM metallic test unit 258 from detector 262 or CODEC 214 via tip-ring pair 223 and metallic hus 260. If there is activity in the voice then metallic testing is deferred until the activity has cleared.

[0025] If there is not activity in the voice frequency range, as determined in decision diamond 310, then a test message is sent to the voice line card 320. Again, this test message may be in the band between voice and DSL band, i.e., an AC signal in the 10 - 16 kHz range. Either detector 262 (if present), CODEC 214 or feed 216 informs processor 228 of the presence of this signal. Processor 228 causes relays 220 and 222 to open normally closed relays 224 and close normally opened relays 226 as in step 330. Processing moves to action box 340 where a timer is set in processor 228. Alternatively, no timer need be set if there is a detector 262. In action box 350 DSLAM metallic test unit 258 can test tip-ring pair from "DC to light".

[0026] After the test is complete in action box 350, a determination is made in decision diamond 360 whether a detector is present. If a detector is present then a "test concluded" message is sent to detector 262 in action box 370. Detector 262 then causes processor 228 to reset relays in action box 380. Otherwise, when the timer times out processor 228 causes the relays to reset. Processing ends in oval 390.

[0027] Turning now to FIG. 4, a flowchart of testing from voice switch metallic test unit 208 is shown. This flowchart is very similar to the one shown in FIG. 3. Processing starts in oval 400 and proceeds to action box 405 wherein processor 228 causes relay pairs 220 and 222 to open normally closed relay 224 and close normally open relays 226, thus disconnecting low-pass filter 218, and the other circuits on DSL-ready line card 204 from tip-ring pair 223. Further, this action connects voice switch metallic test unit 208 to the loop (tip-ring pair)223via metallic test bus 210. Processing then moves to decision diamond 410 where a determination is made whether there is activity in the DSL. This step may be accomplished by sending a signal across tip-ring pair ^{223}either to detector 264 or to transceiver 244. This may be accomplished by sending a signal in the 10 - 16 kHz AC range that is between the voice and the XDSL band. Processor 256 then queries transceiver 244 to determine if DSL activity is present (anything other than idle code, in this exemplary embodiment) or, alternatively, detector 264 can determine if there is energy above a predetermined threshold on tip-ring pair ^{223}In the DSL frequency range. A response is sent back to voice switch metallic test unit 208. If there is activity in the DSL band then processing waits until the activity has cleared. Alternatively, voice switch metallic test unit 208 could determine whether DSL traffic is present on loop 223.

[0028] If there is not activity in the DSL band as determined in decision diamond 410, then a test message is sent to the DSL line card 240. Again, this test message may be an AC signal in the 10 - 16 kHz range. Either detector 264 or transceiver 244 informs processor 256 of the presence of this signal. Processor 256 causes relays 250 and 252 to open normally closed relays 254 and close normally opened relays 256 as in step 430. Processing moves to action box 440 where a timer is set in processor 256 (if the timer is present). Alternative-

ly, no timer need be set if there is a detector 264. In action box 450 voice switch metallic test unit 208 can test tip-ring from "DC to light".

[0029] After the test is complete in action box 450, a determination is made in decision diamond 460 whether a detector is present. If a detector is present then a "test concluded" message is sent to detector 264 in action box 470. Detector 264 then causes processor 256 to reset relays in action box 480. Otherwise, when the timer times out processor 256 causes the relays to reset. Processing ends in oval 490.

[0030] It is to be understood that the above-described embodiment is merely illustrative of the invention and that many variations may be devised by those skilled in the art without departing from the scope of the invention as defined by the appended claims.

Claims

1. A system at a central office for effecting testing of a subscriber loop (223) served by a voice switch (200) and a DSL switch (202), said system being **characterized by**:

   a voice frequency line card (204) connected to the voice switch (200) and having a connection (226) to a first metallic test bus (210), located at the central office, via a first set of relays (220,222) configured to directly connect the first metallic test bus (210) to said subscriber loop (223) and to disconnect said subscriber loop (223) from a voice band circuit (212, 214, 216, 218) of the voice frequency line card;
   a DSL line card (240) connected to the DSL switch (202) and having a connection (256) to a second metallic test bus (260), located at the central office, via a second set of relays (250,252) configured to directly connect the second metallic test bus (260) to said subscriber loop (223) and to disconnect said subscriber loop (223) from a DSL circuit (244) of the DSL line card;
   a voice switch metallic test system (208), located at the central office, directly connected to said first metallic bus (210) via said first set of relays (220, 222) and configured to send signals to control said second set of relays and to provide tests over the entire wireline spectrum through a continuous metal path to the subscriber loop; and
   a DSL metallic test system (258), located at the central office, directly connected to said second metallic bus (260) via said second set of relays (250, 252) and configured to send signals to control said first set of relays (220, 222) and to provide tests over the entire wireline spectrum through a continuous metal path to the subscriber loop.

2. A system in accordance with claim 1 wherein said voice frequency line card (204) includes a DSL ready POTS line card.

3. A system in accordance with claim 1 wherein said voice frequency line card (204) includes a DSL-ready ISDN line card.

4. A system in accordance with claim 1 wherein said voice frequency line card (204) includes a detector (262) configured to cause said first set of relays (220, 222) to operate to disconnect said subscriber loop (223) from the voice band circuit (212, 214, 216, or 218) of the voice frequency line card only if there is no voice band energy above a threshold level present when the DSL metallic test system starts a test.

5. A system in accordance with claim 1 wherein said DSL line card (240) includes a detector (264) configured to cause said second set of relays (250, 252) to operate to disconnect said subscriber loop (223) from the DSL circuit (244) of the DSL line card only if there is no data band energy above a threshold level present when the voice switch metallic test system starts a test..

6. A system in accordance with claim 1 including signaling means in said voice switch (200) for notifying said DSL line card (240) when said voice metallic test system (208) desires testing of said subscriber loop (223).

7. A system in accordance with claim 1 including signaling means in said DSL switch (202) for notifying said voice line card (204) when said DSL metallic test system (258) desires testing of said subscriber loop (223).

8. A system in accordance with claim 1 including means for detecting whether voice signals are present prior to said DSL metallic test system testing said loop, said detecting means inhibiting said DSL metallic test system testing if voice signals are detected.

9. A system in accordance with claim 1 including means for detecting whether DSL signals are present (264) prior to said voice metallic test system (208) testing said loop (223), said detecting means (264) inhibiting said voice metallic test system (208) testing if DSL signals are detected.

10. A system in accordance with claim 1 wherein said metallic tests over the entire wireline spectrum comprise a metallic test from DC to light.

11. A method for testing in a central office a subscriber loop that is connected to both a voice switch (200) and a DSL switch (202) from a metallic test unit (208) in the voice switch (200) in the central office, the method being **characterized by**:

in the voice switch (200), disconnecting a voice line card (204) from the subscriber loop (223);
directly connecting the voice switch metallic test unit (208) to the subscriber loop (223) at the central office;
sending a test message to a DSL line card (240) in the DSL switch (202);
disconnecting the subscriber loop (223) from said DSL line card (240) responsive to said test message;
testing the subscriber loop (223) by the voice switch metallic test unit (208) through the direct connection;
reconnecting said DSL line card (240) to the subscriber loop; and
reconnecting said voice line card (204) to the subscriber loop.

12. A method in accordance with claim 11 including the step of determining whether there is activity in said DSL frequency on the subscriber

loop (223); wherein
the step of sending a test message to the DSL line card (240) is responsive to determining that there is no activity in the DSL frequency.

13. A method in accordance with claim 11 wherein the step of sending a test message to the DSL line card (240) includes generating a signal in a frequency range between an operational frequency range of the voice line card (204) and an operational frequency of the DSL line card (240).

14. A method in accordance with claim 13 wherein the step of generating a signal includes generating an AC signal in the frequency range of 10 -16 kHz.

15. A method in accordance with claim 11 including the step of setting a timer at the central office prior to the step of testing the subscriber loop, and the steps of reconnecting the DSL line card (240) and reconnecting the voice line card (204) are responsive to expiration of the timer.

16. A method for testing at a central office a subscriber loop (223) that is connected to both a voice switch (200) and a DSL switch (202) by a metallic test unit located in the central office, the method being **characterized by**:

in the DSL switch (202), disconnecting a DSL line card (240) from the subscriber loop (223);
directly connecting the DSL switch metallic test unit (258) to the subscriber loop;
sending a test message to a voice line card (204);
disconnecting the subscriber loop (223) from the voice line card (204) responsive to the test message;
testing the subscriber loop (223) by the DSL switch metallic test unit (258) through the direct connection;
reconnecting said voice line card (204) to the subscriber loop; and
reconnecting said DSL line card (240) to the subscriber loop.

17. A method in accordance with claim 16 including the step of determining whether there is activity in the voice frequency on the subscriber loop (223); wherein

the step of sending a test message to the voice line card (204) is responsive to determining that there is no activity in the voice frequency.

18. A method in accordance with claim 16 wherein the step of sending a test message to the voice line card (204) includes generating a signal in a frequency range between an operational frequency range of the voice line card (204) and an operational frequency of the DSL line card (240).

19. A method in accordance with claim 18 wherein the step of generating a signal includes generating an AC signal in the frequency range of 10 -16 kHz.

20. A method in accordance with claim 16 including the step of setting a timer prior to the step of testing the subscriber loop (223), and the steps of reconnecting the DSL line card (240) and reconnecting the voice line card (204) are responsive to expiration of the timer.

Patentansprüche

1. System an einer Vermittlungsstelle zum Bewirken der Prüfung einer, durch eine Sprachvermittlung (200) und eine DSL-Vermittlung (202) bedienten Teilnehmeranschlußleitung (223), **gekennzeichnet durch** folgendes:

eine mit der Sprachvermittlung (200) verbundene Niederfrequenz-Leitungsanschlußkarte (204) mit einer Verbindung (226) mit einem in der Vermittlungsstelle befindlichen ersten metallischen Prüfbus (210) über einen ersten Satz Relays (220, 222) zur direkten Verbindung des ersten

metallischen Prüfbusses (210) mit der Teilnehmeranschlußleitung (223) und zum Abtrennen der Teilnehmeranschlußleitung (223) von einer Sprachbandleitung (212, 214, 216, 218) der Niederfrequenz-Leitungsanschlußkarte;

eine mit der DSL-Vermittlung (202) verbundene DSL-Leitungsanschlußkarte (240) mit einer Verbindung (256) mit einem in der Vermittlungsstelle befindlichen zweiten metallischen Prüfbus (260) über einen zweiten Satz Relays (250, 252) zur direkten Verbindung des zweiten metallischen Prüfbusses (260) mit der Teilnehmeranschlußleitung (223) und zum Abtrennen der Teilnehmeranschlußleitung (223) von einer DSL-Leitung (244) der DSL-Leitungsanschlußkarte;

ein in der Vermittlungsstelle befindliches metallisches Sprachvermittlungs-Prüfsystem (208), das direkt über den ersten Satz Relays (220, 222) mit dem ersten metallischen Bus (210) verbunden und so konfiguriert ist, Signale zum Steuern des zweiten Satzes Relays zu senden und Prüfungen über das gesamte Drahtleitungsspektrum **durch** einen fortlaufenden Metallweg zur Teilnehmeranschlußleitung bereitzustellen; und

ein in der Vermittlungsstelle befindliches metallisches DSL-Prüfsystem (258), das direkt über den zweiten Satz Relays (250, 252) mit dem zweiten metallischen Bus (260) verbunden und so konfiguriert ist, Signale zum Steuern des ersten Satzes Relays (220, 222) zu senden und Prüfungen über des gesamte Drahtleitungsspektrum **durch** einen fortlaufenden Metallweg zur Teilnehmeranschlußleitung bereitzustellen.

2. System nach Anspruch 1, wobei die Niederfrequenz-Leitungsanschlußkarte (204) eine DSL-bereite POTS-Leitungsanschlußkarte enthält.

3. System nach Anspruch 1, wobei die Niederfrequenz-Leitungsanschlußkarte (204) eine DSL-bereite ISDN-Leitungsanschlußkarte enthält.

4. System nach Anspruch 1, wobei die Niederfrequenz-Leitungsanschlußkarte (204) einen Detektor (262) enthält, der so konfiguriert ist, daß er veranlaßt, daß der erste Satz Relays (220, 222) das Abtrennen der Teilnehmeranschlußleitung (223) von der Sprachbandleitung (212, 214, 216 oder 218) der Niederfrequenz-Leitungsanschlußkarte nur dann bewirkt, wenn bei Beginn einer Prüfung durch das metallische DSL-Prüfsystem eine Sprachbandenergie oberhalb eines Schwellwertpegels vorliegt.

5. System nach Anspruch 1, wobei die DSL-Leitungsanschlußkarte (240) einen Detektor (264) enthält, der so konfiguriert ist, daß er veranlaßt, daß der zweite Satz Relays (250, 252) das Abtrennen der Teilnehmeranschlußleitung (223) von der DSL-Leitung (244) der DSL-Leitungsanschlußkarte nur dann bewirkt, wenn bei Beginn einer Prüfung durch das metallische Prüfsystem der Sprachvermittlung keine Datenbandenergie oberhalb eines Schwellwertpegels vorliegt.

6. System nach Anspruch 1 mit Zeichengabemitteln in der Sprachvermittlung (200) zum Benachrichtigen der DSL-Leitungsanschlußkarte (240), wenn das metallische Sprachprüfsystem (208) die Teilnehmeranschlußleitung (223) zu prüfen wünscht.

7. System nach Anspruch 1 mit Zeichengabemitteln in der DSL-Vermittlung (202) zum Benachrichtigen der Sprach-Leitungsanschlußkarte (204), wenn das metallische DSL-Prüfsystem (258) die Teilnehmeranschlußleitung (223) zu prüfen wünscht.

8. System nach Anspruch 1 mit Mitteln zum Erkennen, ob vor dem Prüfen der Anschlußleitung durch das metallische DSL-Prüfsystem Sprachsignale vorliegen, wobei das Erkennungsmittel das Prüfen des metallischen DSL-Prüfsystems sperrt, wenn Sprachsignale erkannt werden.

9. System nach Anspruch 1 mit Mitteln zum Erkennen, ob vor dem Prüfen der Anschlußleitung (223) durch das metallische Sprach-Prüfsystem (208) DSL-Signale vorliegen (264), wobei das Erkennungsmittel (264) das Prüfen durch das metallische Sprach-Prüfsystem (208) sperrt, wenn DSL-Signale erkannt werden.

10. System nach Anspruch 1, wobei die metallischen Prüfungen über das gesamte Drahtleitungsspektrum eine metallische Prüfung von Gleichstrom bis zu Licht umfassen.

11. Verfahren zum Prüfen in einer Vermittlungsstelle einer Teilnehmeranschlußleitung, die sowohl mit einer Sprachvermittlung (200) und einer DSL-Vermittlung (202) verbunden ist, von einer metallischen Prüfeinheit (208) in der Sprachvermittlung (200) in der Vermittlungstelle aus, **gekennzeichnet durch** folgendes:

in der Sprachvermittlung (200), Abtrennen einer Sprach-Leitungsanschlußkarte (204) von der Teilnehmeranschlußleitung (223);

direktes Verbinden der metallischen Sprachvermittlungs-Prüfeinheit (208) mit der Teilnehmeranschlußleitung (223) in der Vermittlungs-

stelle;

Senden einer Prüfnachricht an eine DSL-Leitungsanschlußkarte (240) in der DSL-Vermittlung (202);

Abtrennen der Teilnehmeranschlußleitung (223) von der DSL-Leitungsanschlußkarte (240) als Reaktion auf die Prüfnachricht;

Prüfen der Teilnehmeranschlußleitung (223) **durch** die metallische Sprachvermittlungs-Prüfeinheit (208) über die direkte Verbindung;

Wiederverbinden der DSL-Leitungsanschlußkarte (240) mit der Teilnehmeranschlußleitung; und

Wiederverbinden der Sprach-Leitungsanschlußkarte (204) mit der Teilnehmeranschlußleitung.

12. Verfahren nach Anspruch 11 mit dem Schritt des Bestimmens, ob Aktivität in der DSL-Frequenz auf der Teilnehmeranschlußleitung (223) stattfindet; wobei

der Schritt des Sendens einer Prüfnachricht an die DSL-Leitungsanschlußkarte (240) auf die Bestimmung reagiert, daß keine Aktivität in der DSL-Frequenz stattfindet.

13. Verfahren nach Anspruch 11, wobei der Schritt des Sendens einer Prüfnachricht an die DSL-Leitungsanschlußkarte (240) das Erzeugen eines Signals im Frequenzbereich zwischen einem Betriebsfrequenzbereich der Sprach-Leitungsanschlußkarte (204) und einer Betriebsfrequenz der DSL-Leitungsanschlußkarte (240) umfaßt.

14. Verfahren nach Anspruch 13, wobei der Schritt des Erzeugens eines Signals das Erzeugen eines Wechselstromsignals im Frequenzbereich von 10-16 kHz umfaßt.

15. Verfahren nach Anspruch 11 mit dem Schritt des Einstellens eines Zeitgebers an der Vermittlungsstelle vor dem Schritt des Prüfens der Teilnehmeranschlußleitung, um die Schritte des Wiederverbindens der DSL-Leitungsanschlußkarte (240) und des Wiederverbindens der Sprach-Leitungsanschlußkarte (204) auf den Ablauf des Zeitgebers reagieren.

16. Verfahren zum Prüfen in einer Vermittlungstelle einer Teilnehmeranschlußleitung (223), die sowohl mit einer Sprachvermittlung (200) als auch einer DSL-Vermittlung (202) verbunden ist, durch eine in der Vermittlungsstelle befindliche metallische Prüfeinheit, **gekennzeichnet durch** folgendes:

in der DSL-Vermittlung (202), Abtrennen einer DSL-Leitungsanschlußkarte (240) von der Teilnehmeranschlußleitung (223);

direktes Verbinden der metallischen DSL-Vermittlungs-Prüfeinheit (258) mit der Teilnehmeranschlußleitung;

Senden einer Prüfnachricht an eine Sprach-Leitungsanschlußkarte (204);

Abtrennen der Teilnehmeranschlußleitung (223) von der Sprach-Leitungsanschlußkarte (204) als Reaktion auf die Prüfnachricht;

Prüfen der Teilnehmeranschlußleitung (223) **durch** die metallische DSL-Vermittlungs-Prüfeinheit (258) **durch** die direkte Verbindung;

Wiederverbinden der Sprach-Leitungsanschlußkarte (204) mit der Teilnehmeranschlußleitung; und

Wiederverbinden der DSL-Leitungsanschlußkarte (240) mit der Teilnehmeranschlußleitung.

17. Verfahren nach Anspruch 16 mit dem Schritt des Bestimmens, ob Aktivität in der Niederfrequenz auf der Teilnehmeranschlußleitung (223) stattfindet; wobei

der Schritt des Sendens einer Prüfnachricht an die Sprach-Leitungsanschlußkarte (204) auf die Bestimmung reagiert, daß keine Aktivität in der Niederfrequenz stattfindet.

18. Verfahren nach Anspruch 16, wobei der Schritt des Sendens einer Prüfnachricht an die Sprach-Leitungsanschlußkarte (204) das Erzeugen eines Signals in einem Frequenzbereich zwischen einem Betriebsfrequenzbereich der Sprach-Leitungsanschlußkarte (204) und einer Betriebsfrequenz der DSL-Leitungsanschlußkarte (240) umfaßt.

19. Verfahren nach Anspruch 18, wobei der Schritt des Erzeugens eines Signals das Erzeugen eines Wechselstromsignals im Frequenzbereich von 10-16 kHz umfaßt.

20. Verfahren nach Anspruch 16 mit dem Schritt des Einstellens eines Zeitgebers vor dem Schritt des Prüfens der Teilnehmeranschlußleitung (223), und die Schritte des Wiederverbindens der DSL-Leitungsanschlußkarte (240) und des Wiederverbin-

dens der Sprach-Leitungsanschlußkarte (204) auf den Ablauf des Zeitgebers reagieren.

Revendications

1. Système au niveau d'un central pour effectuer un test de boucle d'abonné (223) desservie par un commutateur vocal (200) et un commutateur DSL (202), ledit système étant **caractérisé par** :

   une carte de ligne de fréquence vocale (204) connectée au commutateur vocal (200) et ayant une connexion (226) avec un premier bus de test métallique (210), située au niveau du central, par l'intermédiaire d'un premier ensemble de relais (220, 222) configuré pour connecter directement le premier bus de test métallique (210) à ladite boucle d'abonné (223) et déconnecter ladite boucle d'abonné (223) d'avec un circuit dans la bande vocale (212, 214, 216, 218) de la carte de ligne de fréquence vocale ;
   une carte de ligne DSL (240) connectée au commutateur DSL (202) et ayant une connexion (256) avec un deuxième bus de test métallique (260), située au niveau du central, par l'intermédiaire d'un deuxième ensemble de relais (250, 252) configuré pour connecter directement le deuxième bus de test métallique (260) à ladite boucle d'abonné (223) et déconnecter ladite boucle d'abonné (223) d'avec un circuit DSL (244) de la carte de ligne DSL ;
   un système de test métallique de commutateur vocal (208), situé au niveau du central, connecté directement audit premier bus métallique (210) par l'intermédiaire dudit premier ensemble de relais (220, 222) et configuré pour envoyer des signaux afin de commander ledit deuxième ensemble de relais et effectuer des tests sur tout le spectre de lignes filaires par le biais d'un trajet métallique continu jusqu'à la boucle d'abonné ; et
   un système de test métallique DSL (258), situé au niveau du central, connecté directement audit deuxième bus métallique (260) par l'intermédiaire dudit deuxième ensemble de relais (250, 252) et configuré pour envoyer des signaux afin de commander ledit premier ensemble de relais (220, 222) et effectuer des tests sur tout le spectre de lignes filaires par le biais d'un trajet métallique continu jusqu'à la boucle d'abonné.

2. Système selon la revendication 1, dans lequel ladite carte de ligne de fréquence vocale (204) comporte une carte de ligne POTS à fonction DSL.

3. Système selon la revendication 1, dans lequel ladite carte de ligne de fréquence vocale (204) comporte une carte de ligne RNIS à fonction DSL.

4. Système selon la revendication 1, dans lequel ladite carte de ligne de fréquence vocale (204) comporte un détecteur (262) configuré pour faire en sorte que ledit premier ensemble de relais (220, 222) fonctionne pour déconnecter ladite boucle d'abonné (223) d'avec le circuit dans la bande vocale (212, 214, 216 ou 218) de la carte de ligne de fréquence vocale uniquement s'il n'y a pas d'énergie dans la bande vocale au-dessus d'un niveau de seuil présente quand le système de test métallique DSL commence un test.

5. Système selon la revendication 1, dans lequel ladite carte de ligne DSL (240) comporte un détecteur (264) configuré pour faire en sorte que ledit deuxième ensemble de relais (250, 252) fonctionne pour déconnecter ladite boucle d'abonné (223) d'avec le circuit DSL (244) de la carte de ligne DSL uniquement s'il n'y a pas d'énergie dans la bande de données au-dessus d'un niveau de seuil présente quand le système de test métallique de commutateur vocal commence un test.

6. Système selon la revendication 1, comportant un moyen de signalisation dans ledit commutateur vocal (200) pour notifier ladite carte de ligne DSL (240) quand ledit système de test métallique vocal (208) désire tester ladite boucle d'abonné (223).

7. Système selon la revendication 1, comportant un moyen de signalisation dans ledit commutateur DSL (202) pour notifier ladite carte de ligne vocale (204) quand ledit système de test métallique DSL (258) désire tester ladite boucle d'abonné (223).

8. Système selon la revendication 1, comportant un moyen pour détecter si des signaux vocaux sont présents avant ledit test de ladite boucle par le système de test métallique DSL, ledit moyen de détection inhibant ledit test par le système de test métallique DSL si des signaux vocaux sont détectés.

9. Système selon la revendication 1, comportant un moyen pour détecter si des signaux DSL sont présents (264) avant ledit test de ladite boucle (223) par le système de test métallique vocal (208), ledit moyen de détection (264) inhibant ledit test par le système de test métallique vocal (208) si des signaux DSL sont détectés.

10. Système selon la revendication 1, dans lequel lesdits tests métalliques sur tout le spectre de lignes filaires comprennent un test métallique du courant continu à la lumière.

11. Procédé pour tester dans un central une boucle d'abonné qui est connectée à la fois à un commutateur vocal (200) et à un commutateur DSL (202) à partir d'une unité de test métallique (208) dans le commutateur vocal (200) dans le central, le procédé étant **caractérisé par** :

dans le commutateur vocal (200), la déconnexion d'une carte de ligne vocale (204) d'avec la boucle d'abonné (223) ;
la connexion directe de l'unité de test métallique de commutateur vocal (208) à la boucle d'abonné (223) au niveau du central ;
l'envoi d'un message de test à une carte de ligne DSL (240) dans le commutateur DSL (202) ;
la déconnexion de la boucle d'abonné (223) d'avec ladite carte de ligne DSL (240) en réponse audit message de test ;
le test de la boucle d'abonné (223) par l'unité de test métallique de commutateur vocal (208) par le biais de la connexion directe ;
la reconnexion de ladite carte de ligne DSL (240) à la boucle d'abonné ; et
la reconnexion de ladite carte de ligne vocale (204) à la boucle d'abonné.

12. Procédé selon la revendication 11, comportant l'étape de détermination d'une activité ou non dans ladite fréquence DSL sur la boucle d'abonné (223) ; dans lequel

l'étape d'envoi d'un message de test à la carte de ligne DSL (240) répond à la détermination qu'il n'y a pas d'activité dans la fréquence DSL.

13. Procédé selon la revendication 11, dans lequel l'étape d'envoi d'un message de test à la carte de ligne DSL (240) comporte la génération d'un signal dans une gamme de fréquences entre une gamme de fréquences opérationnelles de la carte de ligne vocale (204) et une fréquence opérationnelle de la carte de ligne DSL (240).

14. Procédé selon la revendication 13, dans lequel l'étape de génération d'un signal comporte la génération d'un signal C.A. dans la gamme de fréquences de 10 à 16 kHz.

15. Procédé selon la revendication 11, comportant l'étape de réglage d'une temporisation au niveau du central avant l'étape de test de la boucle d'abonné, et les étapes de reconnexion de la carte de ligne DSL (240) et de reconnexion de la carte de ligne vocale (204) sont sensibles à l'arrivée à terme de la temporisation.

16. Procédé pour tester dans un central une boucle d'abonné (223) qui est connectée à la fois à un commutateur vocal (200) et à un commutateur DSL (202) par une unité de test métallique située dans le central, le procédé étant **caractérisé par** :

dans le commutateur DSL (202), la déconnexion d'une carte de ligne DSL (240) d'avec la boucle d'abonné (223) ;
la connexion directe de l'unité de test métallique de commutateur DSL (258) à la boucle d'abonné ;
l'envoi d'un message de test à une carte de ligne vocale (204) ;
la déconnexion de la boucle d'abonné (223) d'avec la carte de ligne vocale (204) en réponse au message de test ;
le test de la boucle d'abonné (223) par l'unité de test métallique de commutateur DSL (258) par le biais de la connexion directe ;
la reconnexion de ladite carte de ligne vocale (204) à la boucle d'abonné ; et
la reconnexion de ladite carte de ligne DSL (240) à la boucle d'abonné.

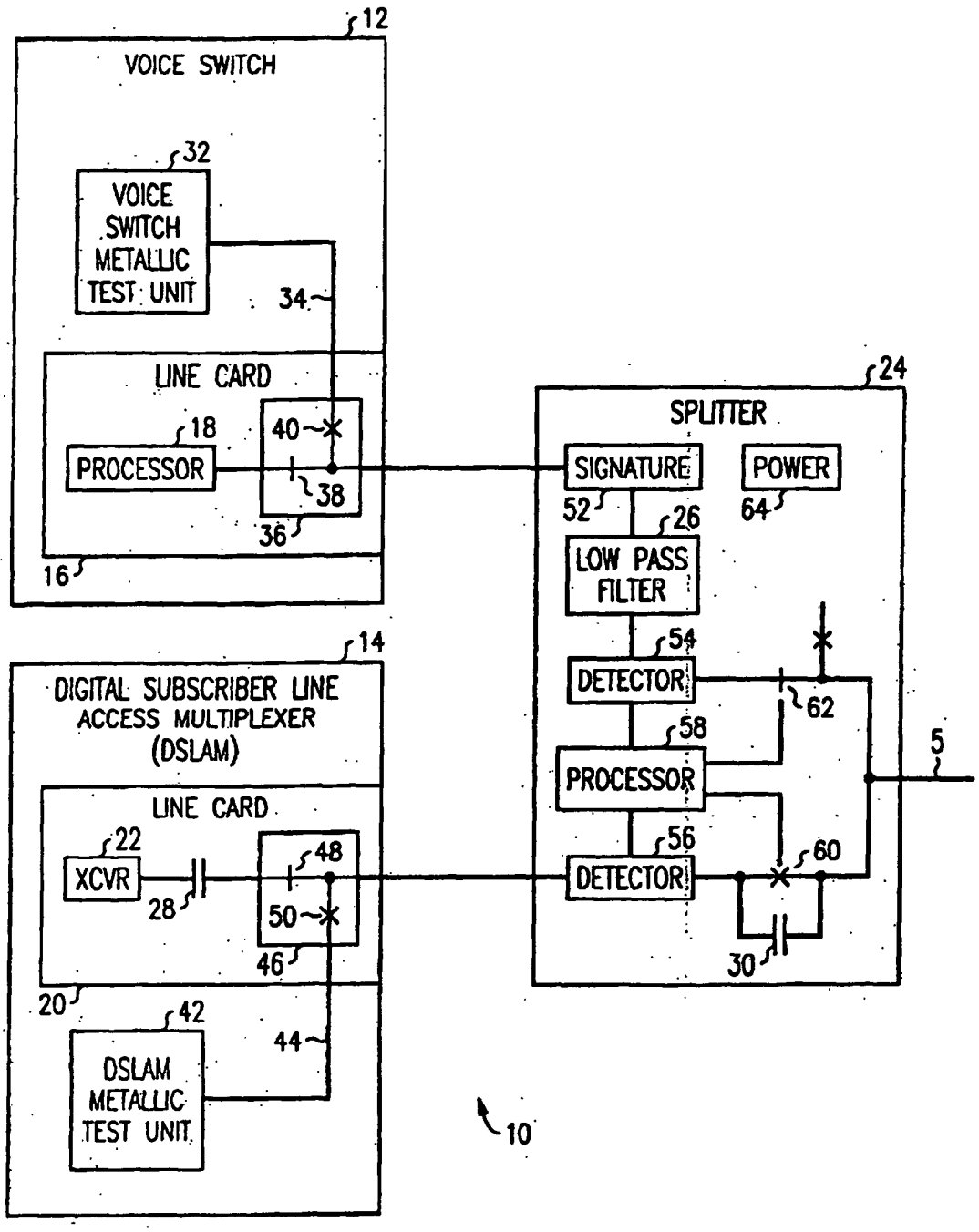
17. Procédé selon la revendication 16, comportant l'étape de détermination d'une activité ou non dans la fréquence vocale sur la boucle d'abonné (223) ; dans lequel

l'étape d'envoi d'un message de test à la carte de ligne vocale (204) répond à la détermination qu'il n'y a pas d'activité dans la fréquence vocale.

18. Procédé selon la revendication 16, dans lequel l'étape d'envoi d'un message de test à la carte de ligne vocale (204) comporte la génération d'un signal dans une gamme de fréquences entre une gamme de fréquences opérationnelles de la carte de ligne vocale (204) et une fréquence opérationnelle de la carte de ligne DSL (240).

19. Procédé selon la revendication 18, dans lequel l'étape de génération d'un signal comporte la génération d'un signal C.A. dans la gamme de fréquences de 10 à 16 kHz.

20. Procédé selon la revendication 16, comportant l'étape de réglage d'une temporisation avant l'étape de test de la boucle d'abonné (223), et les étapes de reconnexion de la carte de ligne DSL (240) et de reconnexion de la carte de ligne vocale (204) sont sensibles à l'arrivée à terme de la temporisation.



(PRIOR ART)

FIG. 1

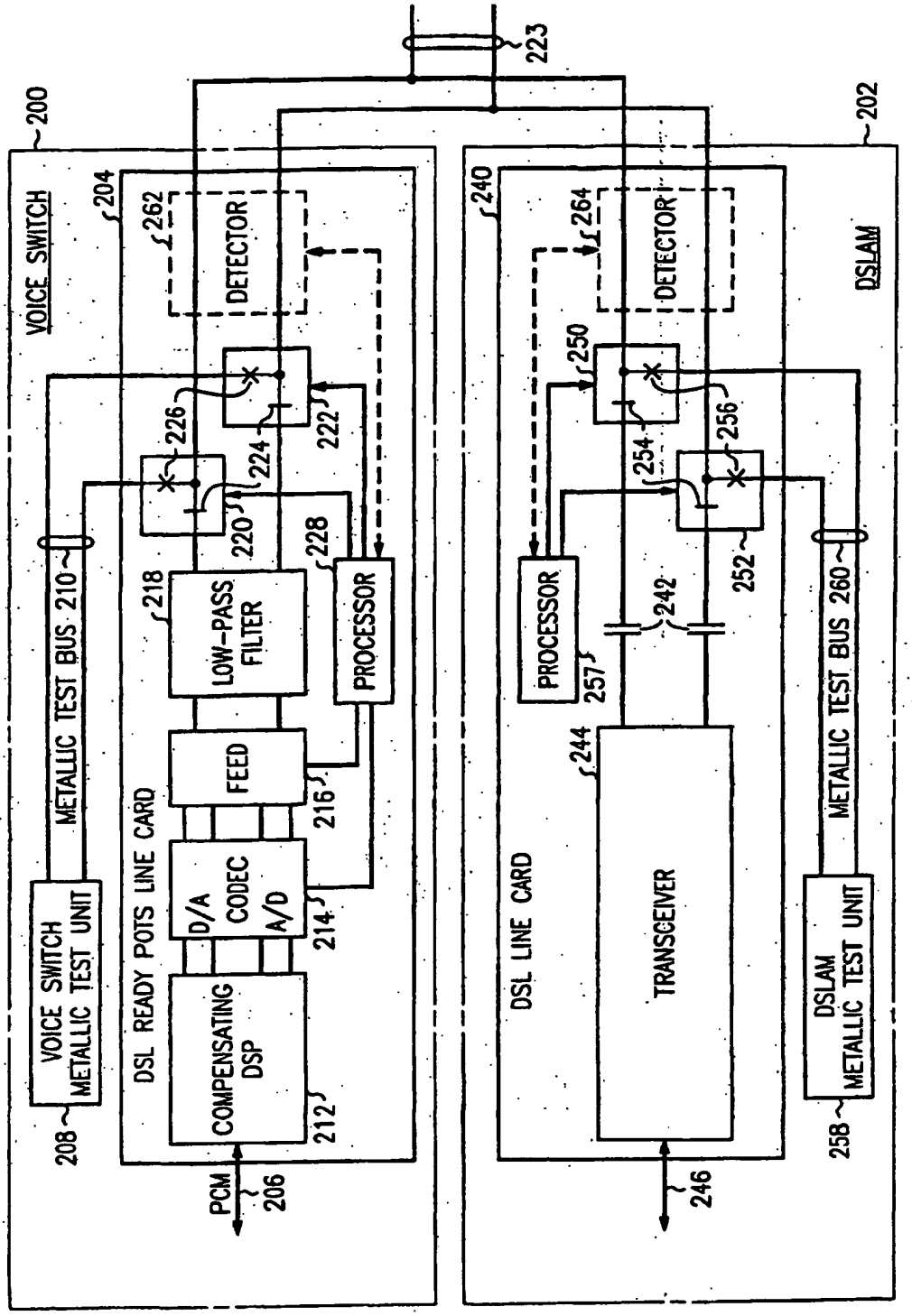

200
VOICE SWITCH
204
DSL READY POTS LINE CARD
VOICE SWITCH METALLIC TEST UNIT
208
METALLIC TEST BUS 210
COMPENSATING DSP
212
D/A CODEC A/D
214
FEED
216
LOW-PASS FILTER
218
PROCESSOR
228
DETECTOR
262
220
224
226
222
PCM
206
223
202
DSLAM
240
DSL LINE CARD
TRANSCEIVER
244
PROCESSOR
257
242
246
DETECTOR
264
250
254
256
252
DSLAM METALLIC TEST UNIT
258
METALLIC TEST BUS 260

FIG. 2

FIG. 3

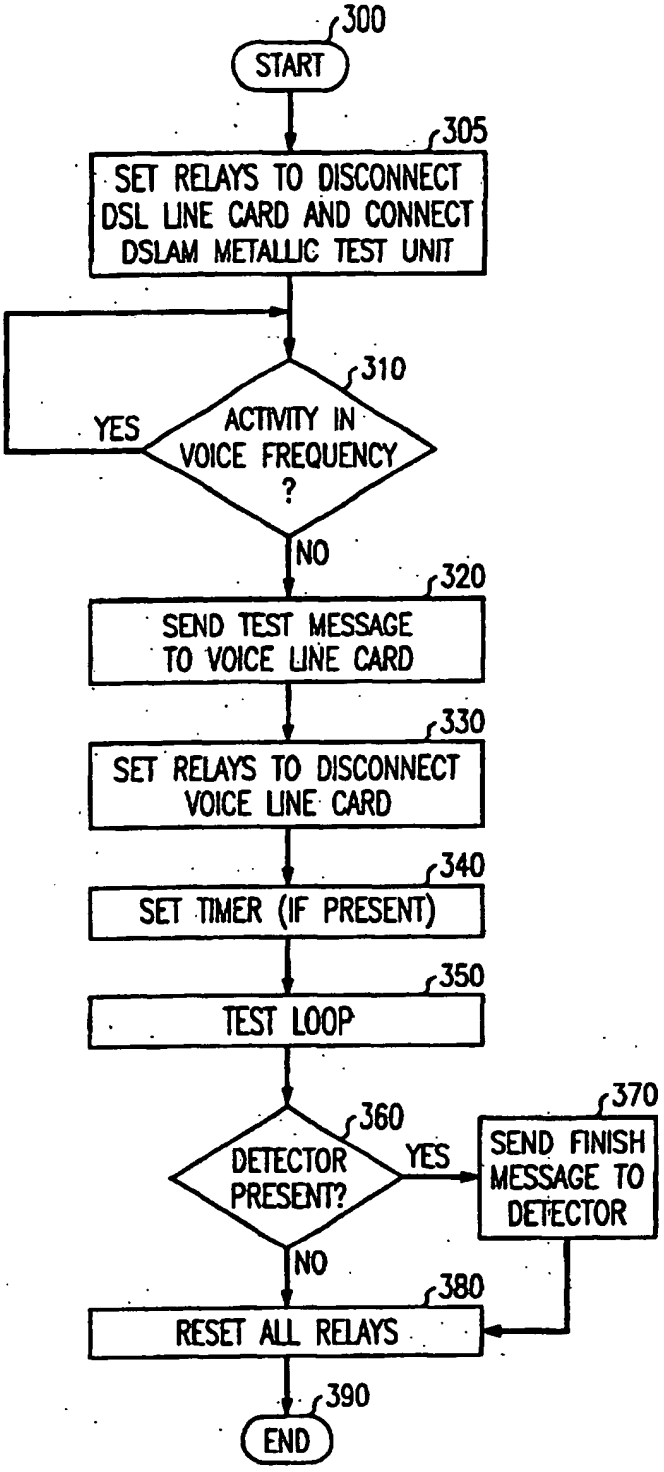
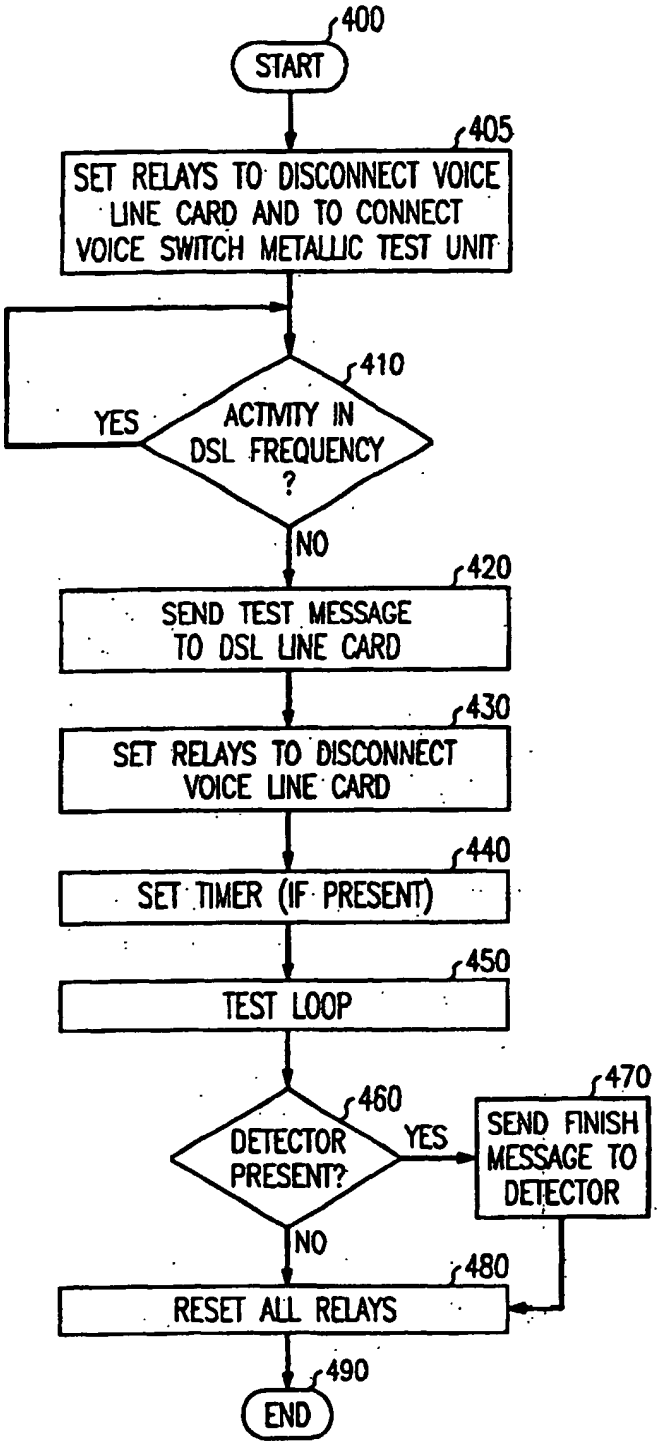

300
START
305
SET RELAYS TO DISCONNECT DSL LINE CARD AND CONNECT DSLAM METALLIC TEST UNIT
310
ACTIVITY IN VOICE FREQUENCY ?
YES
NO
320
SEND TEST MESSAGE TO VOICE LINE CARD
330
SET RELAYS TO DISCONNECT VOICE LINE CARD
340
SET TIMER (IF PRESENT)
350
TEST LOOP
360
DETECTOR PRESENT?
YES
370
SEND FINISH MESSAGE TO DETECTOR
NO
380
RESET ALL RELAYS
390
END

FIG. 4


400
START
405
SET RELAYS TO DISCONNECT VOICE LINE CARD AND TO CONNECT VOICE SWITCH METALLIC TEST UNIT
410
ACTIVITY IN DSL FREQUENCY ?
YES
NO
420
SEND TEST MESSAGE TO DSL LINE CARD
430
SET RELAYS TO DISCONNECT VOICE LINE CARD
440
SET TIMER (IF PRESENT)
450
TEST LOOP
460
DETECTOR PRESENT?
YES
470
SEND FINISH MESSAGE TO DETECTOR
NO
480
RESET ALL RELAYS
490
END